spired with less conscientious ideals. But Miller knew the importance of getting the figures right, and spared no pains to keep his records unbroken.

Dr. Miller was deeply interested in the literature of agricultural chemistry, and unreservedly placed his knowledge of it at the disposal of his colleagues. For many years he did nearly the whole of the abstracting in agricultural chemistry for the Chemical Society, and of late years he wrote the society's annual report on the progress of this subject. He will long be remembered as a painstaking, accurate worker—unhasting, unresting—who, having undertaken a long investigation, would not relinquish it until he had finished it.

E. J. Russell.

NOTES.

At the meeting of the Royal Astronomical Society on Friday, January 12, the president announced that the council had awarded the gold medal of the society to Mr. W. S. Adams, of the Mount Wilson Solar Observatory, for his investigations in stellar spectroscopy, and especially for his determination of absolute magnitudes.

We learn from *Science* that the Bruce gold medal of the Astronomical Society of the Pacific for the year 1917 has been awarded to Prof. E. E. Barnard, of the Yerkes Observatory, for his distinguished services to astronomy. The formal presentation will take place at the annual meeting of the society at San Francisco, on the evening of January 27.

The disease known as "epidemic jaundice" has occurred of late on the Western front. It is caused by a delicate spiral microbe, or spirochæte, which is present in the blood and tissues in small numbers at certain stages; it was discovered by Inada and other Japanese observers in 1914. The organism probably has its natural habitat in the rat, from which man becomes infected either by direct contact or possibly by insect-carriers.

The death is announced, in his seventy-first year, of Dr. T. H. Bean, a former president of the American Fisheries Society. He was for many years connected with the U.S. Fish Commission, and was curator of fishes at the U.S. National Museum from 1880 to 1887. He was director of the New York Aquarium from 1895 to 1898. Since 1906 he had been fish culturist of the State of New York. Dr. Bean was the author of several volumes on ichthyology.

Mr. Udny Yule, one of the honorary secretaries of the Royal Statistical Society, has been appointed head of the Information and Statistical Bureau of the Ministry of Food. With Mr. Yule will be associated Prof. T. B. Wood, Drapers professor of agriculture in the University of Cambridge, and Prof. W. H. Thompson, professor of physiology, Trinity College, Dublin.

The Food Controller announces that he has appointed a committee to make such arrangements as may be necessary and expedient for the increase of supplies of fertilisers in the United Kingdom and for controlling, so far as may be necessary, their output and distribution. The following are the members of the committee:—Capt. C. Bathurst, M.P. (chairman), Mr. H. R. Campbell, Sir James J. Dobbie, Mr. R. R. Enfield, Capt. R. B. Greig, Mr. T. H. Middleton, Mr. W. Anker Simmons, Prof. W. Somerville, Mr. G. J. Stanley, Mr. R. J. Thompson, and Prof. T. B. Wood. Mr. H. Chambers will be the secretary to the committee.

The council of the Geological Society has this year made the following awards:—Wollaston medal, Prof. A. F. A. Lacroix (Paris); Murchison medal, Dr. G. F. Matthew (Canada); Lyell medal, Dr. Wheelton Hind (Stoke-on-Trent); Bigsby medal, Mr. R. G. Carruthers (H.M. Geological Survey); Wollaston Fund, Dr. P. G. H. Boswell (Imperial College of Science); Murchison Fund, Dr. W. Mackie (Elgin); Lyell Fund, Dr. A. H. Cox (King's College, London) and Mr. T. C. Nicholas (Trinity College, Cambridge); Barlow-Jameson Fund, Mr. H. Dewey (H.M. Geological Survey).

Prof. and Mrs. Herdman have recently established and endowed an institute at Port Erin, Isle of Man, as a memorial to their son, Lieut. George A. Herdman, who was killed in action near Montaubon, in the battle of the Somme, on July 1, 1916. Lieut. Herdman spent a great part of his boyhood at Port Erin, associating with the local fishermen and working at the Marine Laboratory, and was well known there. The institute has been handed over permanently to the Commissioners of Port Erin. It is intended for the rest and social intercourse of the men, boatmen, and fishermen of the port, and to extend hospitality to fishermen, yachtsmen, and sailors visiting the harbour. Arrangements are made for the provision of refreshments and recreation, and opportunities for mutual self-education are being given by the collection of a library of works on navigation, fisheries, and general science. The institute was formally opened by Prof. and Mrs. Herdman, and is now available for the men.

Pneumonia is a disease of great importance to South African mining communities, contributing from 30 to 60 per cent. of the total mortality among native mine labourers. An exhaustive investigation upon the disease was conducted in 1911 and 1912 by Sir Almroth Wright and co-workers, and he recommended inoculation with pneumococcus vaccine as a preventive. Dr. F. S. Lister has now completed a further experimental study of the subject. He finds that several races of pneumococci are associated with pneumonia in the Rand, and that rabbits inoculated three times with killed pneumococcal vaccine in suitable doses are resistant to at least eight times the lethal dose of living pneumococcus for an untreated rabbit. For the prevention of the disease in man he recommends that three inoculations, at seven-day intervals, should be employed, each dose consisting of 6000 million pneumococci of each strain against which immunity is desired (the South African Institute for Medical Research, No. VIII., 1916).

The death is announced in the *Morning Post* of Vicomte Charles de Foucauld, the French traveller and scholar. Thirty-five years ago Foucauld resigned from the French Army to travel in Morocco. In the disguise of a Jew merchant he explored parts of the Atlas region which were, and still are, closed to Christians. An account of these travels, entitled "Reconnaissance en Maroc," was published in 1888, and is still regarded as a standard work. It contains invaluable sketches and views and geographical information collected at great risks. After a brief period of travel in the Caucasus, Foucauld became a Trappist monk and returned to Africa. He visited the Targui country, explored it for several years, and collected a vast amount of information on the language, customs, and literature of its people. Later he elected to settle in the desert, and for several years had lived at Tamanraset, half-way between Algeria and French Guinea, where he devoted himself to a study of the country and its people. He never attempted proselytising. Foucauld is reported to have met his death at the hands of brigands, but it is hoped that the valuable manuscripts on the Touareg people which he was preparing may have escaped destruction.

Prof. G. Elliot Smith contributes to the Journal of the Manchester Egyptian and Oriental Society for 1915–16 an important paper on "Ships as Evidence of the Migrations of Early Culture." In this commentary upon certain aspects of the history of shipbuilding, he lays special stress upon the factors which influenced the early development of the shipbuilder's craft in Egypt. "I have indicated how the dug-out became transformed when more efficient tools enabled the Egyptians to shape the vessel, and add beams, at first tied to its sides, to increase its capacity. The shape of the papyrus-boat determined the earliest form of the ship; and the Egyptian conception of the vessel as a living thing led to subsequent modifications in its build. All of these features, with distinctive methods of rigging and steering, represent so many tokens of characteristic Egyptian inventions which can be recognised whereon ships have been built."

The current number of the *Quarterly Journal of Microscopical Science* (vol. lxii., part 1) contains a very complete and interesting account of the development of *Alcyonium digitatum* by Miss Annie Matthews. As this common British species forms the usual laboratory type of the Alcyonaria, an up-to-date description of its development will be of great value to zoological students, and Miss Matthews's work is not only up to date, but also readable. One of the most interesting features of the development is the occurrence of additional, imperfect mesenteries in the primary polyp, a very remarkable fact in view of the constancy with which the normal eight mesenteries occur throughout the entire group, possibly indicating an ancestral condition in which many mesenteries were present. Much light is also thrown upon the order of appearance of the polyps in the young colony, and upon many details of development.

An important paper on the early larval stages of the fresh-water eel (Anguilla) and some other Atlantic Murænoids, by Dr. J. Schmidt, appears in *Meddelelser fra Kommissionen for Havundersogelser, Serie Fiskeri,* Bind v. The author has had the good fortune to obtain a number of specimens of between eight and nine millimetres in length, which are carefully described and figured. He also describes and figures numerous specimens of the American eel, *A. rostrata,* and a number of Leptocephalid forms which he regards as new species. He gives some valuable figures illustrating the development of the hypural bones, and a number of others, greatly enlarged, showing the teeth during these early stages. As to the nature of the food seized by these teeth, and the precise use of the anterior grasping teeth, which are long, median in position, and forwardly directed, nothing appears to be known.

The *National Geographic Magazine* for November, 1916, is devoted to the description of the larger American mammals, and is illustrated by no fewer than thirty-two coloured plates of remarkable beauty by Louis Agassiz Fuertes, and in addition to these are a number of uncoloured plates of no less merit. The text is by Mr. E. W. Nelson, the assistant-chief of the U.S. Biological Survey, and is thus in every way worthy of the illustrations. The descriptions are of necessity brief, but they are sufficient to furnish a survey of the salient features of each of the species described, its haunts, range, and numbers. We regret to note that the prong-horn antelope is almost as much in danger of extermination as the sea-otter. Having regard to the jealous guardianship which is now displayed over the native fauna, it is surprising to be told that complaint has to be made of "the despicable work of poachers, who are shooting elk [wapiti] for their two canine teeth, and leaving the body to the coyotes." Information has been received that more than 500 were ruthlessly slaughtered for this purpose about the border of Yellowstone National Park during the winter of 1915–16 In referring to the size of the bull sperm-whale no mention was made of the very great disparity in size between the male and the female, nor is any mention made of the teeth of the upper jaw of the male.

We regret to learn that that old-established and very useful journal, the *Zoologist,* ceased to exist with the issue of the December number. In name, at any rate, it still survives, since it has been incorporated with *British Birds,* published by Messrs. Witherby and Co. All other branches of natural history which found a place in the *Zoologist* will, however, now be excluded. This we gather from the January number of *British Birds,* which, at the same time, makes the welcome announcement that in future its pages will be open to articles and notes on the avifauna of other parts of the western portion of the Palæarctic region, or, in other words, of Europe and North-West Africa. This number includes some valuable observations "On the Breeding Habits of the Red-backed Shrike," by Mr. J. H. Owen. The author believes that the cock is responsible for the "larder" peculiar to the shrikes, and that it is usually made during the incubating period, presumably for the use of the female. The indigestible parts of the food are thrown up by the young birds, he remarks, in the form of pellets. These are often so large that the very young birds are unable to expel them, so that they have to be drawn out of the mouth by one of the parents. Both birds take part in cleaning the nest, and the excrement for the first few days is swallowed by them, but later it is generally carried away and dropped at a distance from the nest.

According to the *Chemical Trade Journal* of December 30 the Trade and Industry Committee of the Royal Colonial Institute has investigated the properties of the grass lalang, which is found in large quantities close to the coasts of Malaya, as a possible paper-making material. The grass, which can be obtained for the mere cost of collection, is shown by chemical analysis to be capable of yielding a good quantity of cellulose, quite suitable for the manufacture of paper. It is very susceptible to the action of dilute alkalis, but the final product is unusually pure and readily resolved. After washing, the pulp obtained is uniform in quality and of good colour, and, subject to judicious treatment for the improvement of the latter, it would furnish a paper very suitable for printing purposes. A high-class wrapping paper, strong, and having a comparatively high resistance to folding, would be obtained by using a mixture of half lalang grass pulp and half cotton beaten together.

The November issue of the *Journal of the Board of Agriculture* contains a useful summary of experimental work with palm-kernel cake carried out during the past year by Prof. C. Crowther and his colleagues in the Agricultural Department and Institute for Research in Animal Nutrition of the University of Leeds. The work includes studies of the palatability, digestibility, and keeping properties of the cake, together with an examination of its effects upon the yield and composition of milk and butter. Apart from an initial reluctance of the animals to eat the cake, which was traced to difficulties of mastication, the results were generally favourable, and demonstrated that the cake possesses qualities which should secure its permanent inclusion in the list of feeding-stuffs widely used on British farms. Further work with palm-kernel products is reported by Prof. C. Crowther in the December issue of the same journal, in an account of a practical feeding experiment with pigs, carried out on behalf of the Co-operative Wholesale Society at their farm near Clitheroe. In this experiment with three groups of eighteen pigs each, palm-kernel cake and extracted palm-kernel meal were compared with the grade of milling offals known as "thirds." The cake proved an efficient and economical substitute for "thirds," and appreciably superior to the meal. These results should usefully supplement the great efforts now being made to secure for this country the palm-kernel crushing industry, the great importance of which from Imperial and national points of view was strikingly revealed in the recently issued report of the Edible Nuts Committee of the Colonial Office.

An article on river frontiers in Europe, by Prof. L. W. Lyde (*Scottish Geographical Magazine*, xxxii., pp. 545–555), is an able rejoinder to Sir T. H. Holdich's well-known views on the subject. Prof. Lyde holds that as war is not a normal condition, it is surprising that the accepted theory of frontiers is essentially a military one, the object of which is not to effect an international equilibrium across it, but to make international intercourse, peaceful or otherwise, impossible. Prof. Lyde maintains that the principle of democracy is sufficiently mature to demand that boundaries should make for peace as well as for security. A navigable river encourages peaceful intercourse, and so has a civilising influence which cannot be said of any barrier which keeps peoples apart. Sir T. H. Holdich admits that a river makes a good boundary except on its plain course. But this contention, Prof. Lyde says, must be modified in the light of events in the present war. The Danube proved to be an absolute defence to Belgrade during four months in 1914, and in the great Russian retreat rivers backed by railways were defensive positions of enormous strength. Prof. Lyde cites the Plate, the St. Lawrence, and the lower Danube to show that a navigable river does not of necessity form an unstable boundary and become the property of the most pushing nation on its banks. Again, economic equilibrium, a necessary factor in international equilibrium, is more likely to result from a river frontier, as that will hold a fair balance of the mineral and other wealth on either side. The author holds that if the new map of Europe is based on purely military lines, Europe will have to expiate it once more on purely military lines.

Mr. E. L. Troxell traces back the one-toed horse to a new species, *Pliohippus lullianus*, discovered by him in the Lower Pliocene of S. Dakota (*Am. Journ. Sci.*, vol. xlii., p. 335, 1916). This horse presents the unique feature of an ulna unfused at any point with the radius.

An interesting case of the replacement of calcite by iron pyrites as the cementing material of a sandstone is given by Mr. T. A. Jones in a note on Permo-Triassic sandstones of South-west Lancashire (Proc. Liverpool Geol. Soc., vol. xii., p. 257, 1916). It may be remembered that even quartz has been thus replaced during the formation of concretions in certain Karroo sandstones (see Nature, vol. xcv., p. 216).

Geologists interested in the much-discussed stratigraphy of New Zealand will find new material concerning the junction of Cretaceous and Cainozoic horizons in a paper by Mr. P. G. Morgan ("Notes of a Visit to Marlborough and North Canterbury, with especial reference to Unconformities post-dating the Amuri Limestones," Geological Survey, N.Z., tenth annual report (1916), p. 17). The unconformities traced by the author do not, as the title might imply, assign a date to the Amuri Limestones, but are above this horizon, and the lowest one divides the upper limestone from the Weka Pass Stone. This break is shown to be widespread, but, like the others, may not be continuous throughout New Zealand.

A "Catalogue of the Collection of Meteorites" belonging to the Geological Survey of India, and preserved in the Indian Museum in Calcutta, is given by Mr. J. Coggin Brown in the Memoirs of the Geological Survey of India (1916, vol. xliii., part 2, pp. 149–287). The private collection of the late R. P. Greg, purchased in 1865, formed the nucleus of this collection, which now represents 379 meteoritic falls, and is the largest in Asia. Previous catalogues were prepared in 1867 by Thomas Oldham, and in 1879–80, with a supplement in 1901. The main part of the present catalogue is occupied by an alphabetical list of the specimens arranged under the geographical names of the falls. There are brief descriptions of the individual specimens and their weights are recorded. A second short list gives an outline of the Brezina classification of meteorites, with the names of falls represented in the collection under each of the seventy-four groups.

Among the Memoirs of the National Academy of Sciences of Washington (1916, xiv., pp. 1–29) Dr. G. P. Merrill, the head curator of geology in the United States National Museum, has recently published a report on researches on the chemical and mineralogical composition of meteorites, with especial reference to their minor constituents. When preparing an earlier paper on a similar subject he had been struck with the comparatively small number of trustworthy analyses available, and the apparent similarity in, and simplicity of, the composition of meteorites. At his instigation careful analyses were made of twenty typical meteorites, ranging from irons to stones, by Dr. J. E. Whitfield, of Messrs. Booth, Garrett, and Blair, in Philadelphia, and the results obtained are tabulated, and in some instances compared with those published by earlier workers. Occasionally considerable discrepancies were revealed, the most remarkable being in the case of the Collescipoli stone, in which none of the rare elements noted by Trottarelli could be found; on the other hand, whereas the latter gives nearly 8 per cent. of sulphur, Dr. Whitfield found none, and yet in the description of the stone the presence of metallic sulphide is noted. The analysis of meteorites is a task calling for care, skill, and unlimited patience owing to the paucity of material usually available and the necessity for testing for so many elements which can only be present in extremely small amounts, and it should, moreover, be combined with a careful microscopic examination of thin sections; obviously such work can only be undertaken as a labour of love.

Some excellent specimens of the important tungsten ores, wolframite and scheelite, have just been received at the Imperial Institute from the Federated Malay States, and can be seen in the Malay Court of the Exhibition Galleries. As is now well known, the most important use of tungsten ores is in the manufacture of tungsten steel, of which large quantities are now being employed in munition factories in Sheffield and elsewhere in the manufacture of high-speed tools and for other special purposes. Tungsten is also used in the form of wire in the manufacture of metallic filaments for electric lamps. Wolframite, commonly called wolfram, which forms the bulk of the tungsten ore produced, occurs in various parts of the main mountain range in British Malaya, and in Pahang and Trengganu. Scheelite is mined in Perak and Selangor.

THE current issue (vol. xlvii., part 3) of the Records of the Geological Survey of India contains a review of the mineral production of India during 1915, compiled by the Director of the Survey. The results may fairly be described as satisfactory, having regard to the conditions set up by the European War. The total value of the mineral products shows an increase of more than 700,000*l.* above that for 1914, some of this increase being undoubtedly due to the higher prices obtained for many of the products. The most important of these, however—coal—actually shows a decrease in value of 126,000*l.*, although the output has risen from 16,464,000 tons to 17,104,000 tons, due to the lack of sufficient shipping to transport it, in consequence of which the price at the pits necessarily declined. The gold output is practically the same as in 1914, but important increases in production are shown in tinstone, wolfram, and lead ore; these minerals come almost exclusively from Burma, where considerable attention has recently been paid to the improvement of the means of transport and other facilities for the development of the mineral resources of the country. Petroleum is another mineral the production of which shows a very considerable increase. There has been a fall, on the other hand, in the output of manganese ore and iron ore; the reason for the former is to be found in the difficulty of obtaining tonnage and in the high rates of freight. In this connection it is interesting to be able to chronicle the first attempt to utilise the ore within the peninsula, the Tata Company having put a furnace on to ferromanganese, of which 2658 tons were produced. Attention may also be directed to two pamphlets issued by the Department of Mines and Geology of the State of Mysore, one giving a brief account of the mineral resources of the State, which include, in addition to gold, ores of chromium, iron, and manganese, and the other a synopsis of the laws and regulations governing the issue of mineral licences; both these publications should prove of great interest to all who are, or are likely to be, interested in mining in this part of India.

IT is well known that the factors which determine the rate of evaporation of water from the earth's surface are the depth of the surface of the water underground, the nature of the soil above this surface, the temperature and humidity of the air, and the speed with which it is moving. To a great extent the nature of the influence of each of these factors on the evaporation is known, but it has not been possible to determine the quantitative laws connecting them. The results of a research carried out by Messrs. F. S. Harris and J. S. Robinson at the Utah Agricultural Experimental Station during the past four years, and published in the United States Department of Agriculture Journal of Research for December 4, 1916, appear to justify the belief that before long these laws will have been discovered. By keeping the water level only a centimetre below the level of the surface of the sand or soil used, the authors have greatly reduced the effect of capillarity, and are able to give curves showing the effects of percentage of water in the soil, of the amount of dissolved salts in the water, of the size of grains and compactness of the soil, and of the speed, temperature, and humidity of the air on the rate of evaporation. Copies of the paper may be obtained from the Government Printing Office, Washington, at 10 cents a copy.

WHILE the name of Pappus of Alexandria is associated in the minds of modern mathematicians with Guldin in the theorem relating to the volume and area of the surface traced out by a moving closed curve, practically nothing is known of the life of the geometer himself. An introductory paper on Pappus is now given by Dr. J. H. Weaver in the December Bulletin of the American Mathematical Society. Of the eight works attributed to him, the only one extant even in part is the "Collectio," which is a summary in eight books of the works of preceding Greek mathematicians, of which Dr. Weaver gives a general account. Of this an edition was published by Hultsch, of Berlin, in 1876–78. Reference is also made to Sir T. J. Heath's article on Pappus in the "Encyclopædia Britannica," eleventh edition.

AN outline of the mathematical course of an Italian technical school is given by Prof. Virgil Snyder in the Bulletin of the American Mathematical Society (xxiii., 3). The account refers to the Reale Istituto Tecnico Superiore of Milan, where, as elsewhere in Italy, the course extends over five years, and includes a two-year course in mathematics, physics, and chemistry, as also in Italian and two other languages. Candidates for admission are required to be familiar with plane and solid geometry, plane trigonometry, algebra including determinants, theory of equations, graphical processes, and elementary projective geometry. Differential calculus is only commenced as a portion of a heavy course in the first term, and integration in the second term is taken by the students, together with an extensive discussion of analytical solid geometry.

WHEN all the roots of an algebraic equation are complex with modulus unity, it is fairly evident that the equation must be reciprocal. Writing in the *Tohoku Mathematical Journal* (x., 3), Mr. A. Kempner, of Urbana, U.S.A., gives certain extensions of previous work relating to equations having roots of this special form, and in particular proposes a simple proof of the theorem that if *one* such pair of roots exists the equation must be reciprocal provided that it is irreducible in the domain of rationality formed by the coefficients. The journal contains the usual summary of new books and contents of mathematical periodicals, of which the latter form a very useful reference catalogue of current mathematical literature. We could wish, however, that this portion, appealing as it does to readers of all nations, did not contain so much matter in Japanese characters, or that a translation were given in English or French.

WE have received an official publication of the Government of South Australia entitled "An Investigation into the Prospects of Establishing a Paper-making Industry in South Australia," by Mr. W. A. Hargreaves, being Bulletin No. 1 of the Department of Chemistry, of which the author is director, and "issued under the authority of the Hon. R. P. Blundell, Minister of Industry." Of indigenous raw materials for paper-making Australia presents a conspicuous dearth, and Mr. Hargreaves's conclusion from his exhaustive investigations is that the only immediate industrial proposition is the utilisation of cereal straws: lime-boiled for "strawboards" and caustic-boiled for "cellulose" papers—*i.e.* for printings and writings; in the latter case the paper-furnish requiring from 30–40 per cent. of bleached wood cellulose, which means an imported raw material. The cost of production of the bleached straw pulp from the hypothetical works' cost-sheets is 7*l.*–8*l.* per ton; the process described and "costed" is based on the caustic-soda boil, with 80 per cent. recovery, and the assumption that "the losses of caustic soda are made up with sodium sulphate, because it is cheaper." There is no reference to the consequent modification of the entire scheme in terms of the main product (cellulose) and of the offensively malodorous volatile by-products. To the main report is appended one by Mr. D. C. Winterbottom on "Supplies and Cost of Raising 'Marine Fibre,'" the remarkable product of *Posidonia australis.* For the industrial utilisation of this product more than one "promotion" has been attempted; according to the author, two of these survive, of which the Posidonia Fibres Syndicate is producing six to seven tons per week at Port Broughton. On his estimate of the costs of dredging, etc. (4*l.* 10*s.* 6*d.*), and subsequent handling, the clean, air-dry fibre cannot be produced to sell at less than 17*l.* per ton. A second appendix, by Mr. J. C. Earl, on the paper-making value of various South Australian raw materials, deals with six indigenous products of little promise.

WAR problems and after-the-war problems are discussed by writers of every varying shade of opinion in *Scientia,* the Italian equivalent of our own *Science Progress,* but which exhibits a more international tendency by publishing French translations of English and Italian articles. Thus Prof. Sayce (xix., 5) considers that the history of the Assyrian empire under Tiglath Pileser and his successors affords a lesson as to what may be expected from a military nation imbued with the spirit of world-conquest. In the same number Prof. Roberto Michels, of Turin and Bâle, deals with the demolition of the international labour movement. Prof. Knut Wicksell (Lund, Sweden) discusses the influence of over-population in stimulating wars, and expresses the somewhat sanguine prophecy that with the present decline of the birth-rate in European countries peace conditions may become more possible (xix., 6). Prof. A. Pillet, of Paris (xx., 12), considers that the problem of the war from the Allies' point of view involves the entire crushing of the German Empire. Peace conditions and what is to happen after the war form the subject of speculations at the hands of Prof. E. Catellani, Padua (xx., 8), and E. Cecotti, Messina (xx., 6). Sir Alfred Hopkinson (xx., 12), while emphasising the strict adherence to the principles of international law in the operations of the Allies, blames the neutral countries for not taking action in enforcing the observance of similar principles on the enemy. But an attempt is made to apply the methods of exact science to the problem of when and what offers of peace should be made by a victorious belligerent, in a paper on "The Economic Dynamics of War," by Prof. John Bates Clark, of Columbia University. In his opinion the time for making the offer is when the gain to be derived from continuing the war is more than outbalanced by the sacrifice required for its continuance. And the terms to be exacted from the vanquished side should consist of all that the prospective victor could gain by pushing his conquest to the bitter end *minus* the cost of so pushing it. If these terms are offered and can be secured there is no advantage for either side to continue the struggle.

THE Open Court Company will publish very shortly a translation, from the first edition, of "The Geometrical Lectures of Isaac Barrow." The work will contain a portrait of Barrow, and an introduction and notes by J. M. Child.

OUR ASTRONOMICAL COLUMN.

AURORA BOREALIS.—Mr. Denning writes that though the moon was nearly full on the evening of January 4 there was a brilliant occurrence of aurora observed from widely distant stations. The Rev. W. F. A. Ellison observed it from Fethard-on-Sea, near Waterford, and describes it as a particularly magnificent display. From Edinburgh, at about 10 p.m., there was also a fine exhibition, extending along a considerable range of the northern horizon. Rapid variations were apparent in the details, the light alternately appearing and disappearing. Clouds were very prevalent at low altitudes in the northern region, and the glow spread upwards from behind these with striking effect. At Bristol there was an auroral glow between about 8 and 9 p.m., and at 8.30 a bright streamer shot upwards to about 15° W. of the Pole star. But the appearance was rendered somewhat inconspicuous by the unusual brilliancy of the moon, due to the very clear atmosphere.

Dr. A. A. Rambaut, Radcliffe Observatory, Oxford, sends us the following notes of observations of this aurora made by Mr. W. H. Robinson at that observatory, and also of the bright meteor of the same date, referred to in last week's NATURE (p. 379):—A bright haze in the northern sky attracted considerable attention at Oxford soon after 8 p.m. on January 4. A long segment of an auroral arch lay along the horizon, with its apex at a small altitude in the N.N.W. Isolated streamers appeared, but generally for a few seconds only. The finest display occurred at 10.15 p.m. (or perhaps a minute or so later), when streamers suddenly developed all along the arch, lasting for a very brief interval, a white haze taking its place. At about 10.15 p.m. a brilliant fireball attracted notice, which ran rapidly downwards from the direction of the moon, passed 2° or 3° east of Jupiter, and burst, with a blue colour, 10° or 15° below the planet, its trail swiftly disappearing. The light of the meteor was distinctly more intense than that of the moon. An approximate estimate places the track from 3h. 0m., +18° (first seen), to 0h. 45m., +5°.

CLOUDS ON MARS.—In the course of a report on the planet Mars, in which observations made by members of an international organisation are summarised and compared, Prof. W. H. Pickering makes several interesting references to clouds which appeared on the planet during the opposition of last year (*Popular Astronomy,* vol. xxiv., p. 639). Clouds were seen frequently by all the observers, and Prof. Pickering points out that the clouds always lie over the so-called desert regions of the planet, apparently being precipitated so soon as the fertile regions are reached. Dissolution is sometimes very rapid. Only a few years ago it was claimed by some observers that clouds were rarely or never to be seen on Mars, but during the last opposition the planet was scarcely ever seen without them. The existence of clouds in the atmosphere of Mars appears to have been first established by Sir Norman Lockyer in his observations during the opposition of 1862.

THE CEPHEID VARIABLES.—The results of some further investigations of the relations between the orbital elements of Cepheid stars have been given by Dr. Ludendorff (*Astronomische Nachrichten,* No. 4869). He finds that for several stars resembling δ Cephei, the elements are closely related, as shown in the formula

$$100e \cos \omega = -21{\cdot}8 + 0{\cdot}963(1-e^2)^{\frac{3}{2}}K^3P.10^{-3},$$

where e, ω, P are respectively the eccentricity, angle from periastron to node, and the period in days, while K is half the total amplitude of the radial velocity.

A similar formula is applicable to stars resembling ζ Geminorum, the two numbers on the right-hand side of the equation then becoming +2·4 and +0·73. Further confirmation has been obtained of the relation previously given by Dr. Ludendorff, 2K = 47·3 A, where A is the range of variation in brightness expressed in magnitudes; this, however, appears to be valid only for stars of types F to G.